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ECG semiconductors

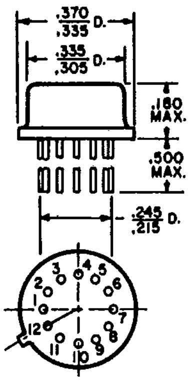
ECG906

DUAL HIGH-FREQUENCY DIFFERENTIAL AMPLIFIER

For Low-Power Applications at Frequencies up to 500 MHz

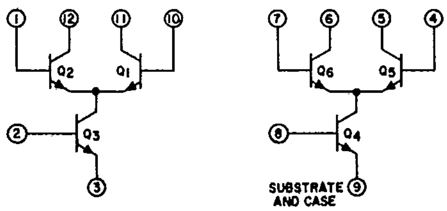
ECG906 consists of two independent differential amplifiers with associated constant-current transistors on a common monolithic substrate. The six transistors which comprise the amplifiers are general-purpose devices which exhibit low l/f noise and a value of f_T in excess of 1 GHz. These features make the ECG906 useful from dc to 500 MHz. Bias and load resistors have been omitted to provide maximum application flexibility.

The monolithic construction of the ECG906 provides close electrical and thermal matching of the amplifiers. This feature makes these devices particularly useful in dual-channel applications where matched performance of the two channels is required.



Features:
- Power Gain 23 dB (typ.) at 200 MHz
- Noise Figure 4.6 dB (typ.) at 200 MHz
- Two differential amplifiers on a common substrate
- Independently accessible inputs and outputs
- Full military-temperature-range capability (−55°C to + 125°C)

Applications
- VHF amplifiers
- VHF mixers
- Multifunction combinations — RF/Mixer/Oscillator; Converter/IF
- IF amplifiers (differential and/or cascode)
- Product detectors
- Doubly balanced modulators and demodulators
- Balanced quadrature detectors
- Cascade limiters
- Synchronous detectors
- Balanced mixers
- Synthesizers
- Balanced (push-pull) cascode amplifiers
- Sense amplifiers



Schematic Diagram

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MAXIMUM RATINGS, ***ABSOLUTE-MAXIMUM VALUES, AT T_A = 25°C***

Power Dissipation, P:

Any one transistor	300
Total package	600
For $T_A > 55°C$ Derate at:	5

Temperature Range:

Operating............	−55 to + 125
Storage	−65 to + 150

The following ratings apply for each transistor in the devices

Collector-to-Emitter Voltage, V_{CEO}	15	V
Collector-to-Base Voltage, V_{CBO}	20	V
Collector-to-Substrate Voltage, V_{CIO}*	20	V
Emitter-to-Base Voltage, V_{EBO}	5	V
Collector Current, I_C	50	mA

*The collector of each transistor is isolated from the substrate by an integral diode. The substrate (terminal 9) must be connected to the most negative point in the external circuit to maintain isolation between transistors and to provide for normal transistor action.

ELECTRICAL CHARACTERISTICS at T_A = 25°C

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS		LIMITS MIN.	TYP.	MAX.	UNITS
STATIC CHARACTERISTICS							
For Each Differential Amplifier							
Input Offset Voltage	V_{IO}			---	0.25	---	mV
Input Offset Current	I_{IO}	$I_3 = I_9 = 2$ mA		---	0.3	---	µA
Input Bias Current	I_{IB}				13.5	33	µA
Temperature Coefficient Magnitude of Input-Offset Voltage	$\frac{\lvert\Delta V_{IO}\rvert}{\Delta T}$			---	1.1	---	µV/°C
For Each Transistor							
DC Forward Base-to-Emitter Voltage	V_{BE}	$V_{CE} = 6$ V, $I_C = 1$ mA		---	774	---	mV
Temperature Coefficient of Base-to-Emitter Voltage	$\frac{\Delta V_{BE}}{\Delta T}$	$V_{CE} = 6$ V, $I_C = 1$ mA		---	-0.9	---	mV/°C
Collector-Cutoff Current	I_{CBO}	$V_{CB} = 10$ V, $I_E = 0$		---	0.0013	100	nA
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 1$ mA, $I_B = 0$		15	24	---	V
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 10$ µA, $I_E = 0$		20	60	---	V
Collector-to-Substrate Breakdown Voltage	$V_{(BR)CIO}$	$I_C = 10$ µA, $I_B = 0$, $I_E = 0$		20	60	---	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 10$ µA, $I_C = 0$		5	7	---	V
DYNAMIC CHARACTERISTICS							
1/f Noise Figure (For Single Transistor)	NF	f = 100KHz, $R_S = 500\ \Omega$, $I_C = 1$ mA		---	1.5	---	dB
Gain-Bandwidth Product (For Single Transistor)	f_T	$V_{CE} = 6$ V, $I_C = 5$ mA		---	1.35	---	GHz
Collector-Base Capacitance	C_{CB}	$I_C = 0$	$V_{CB} = 5$V	--- ---	0.28 0.28	--- ---	pF pF
Collector-Substrate Capacitance	C_{CI}	$I_C = 0$	$V_{CI} = 5$V	---	1.65	---	pF
For Each Differential Amplifier							
Common-Mode Rejection Ratio	CMR	$I_3 = I_9 = 2$ mA		---	100	---	dB
AGC Range, One Stage	AGC	Bias Voltage = −6V		---	75	---	dB
Voltage Gain, Single-Ended Output	A	Bias Voltage = −4.2V, f = 10 MHz		---	22	---	dB
Insertion Power Gain	G_p	f = 200 MHz	Cascode	---	23	---	dB
Noise Figure	NF	$V_{CC} = 12$V	Cascode	---	4.6		dB
Input Admittance	Y_{11}	For Cascode Configuration	Cascode	---	1.5 + j 2.45	---	mmho
		$I_3 = I_9 = 2$ mA	Diff.Amp.	---	0.878 + j 1.3	---	
Reverse Transfer Admittance	Y_{12}	For Diff. Amplifier Configuration	Cascode	---	0 − j 0.008	---	mmho
		$I_3 = I_9 = 4$mA	Diff.Amp.	---	0 − j 0.013	---	
Forward Transfer Admittance	Y_{21}	(each collector	Cascode	---	17.9 − j 30.7	---	mmho
		$I_C \simeq 2$mA)	Diff. Amp.	---	− 10.5 + j 13	---	
Output Admittance	Y_{22}		Cascode	---	− 0.503 − j 15	---	mmho
			Diff.Amp.	---	0.071 + j 0.62	---	

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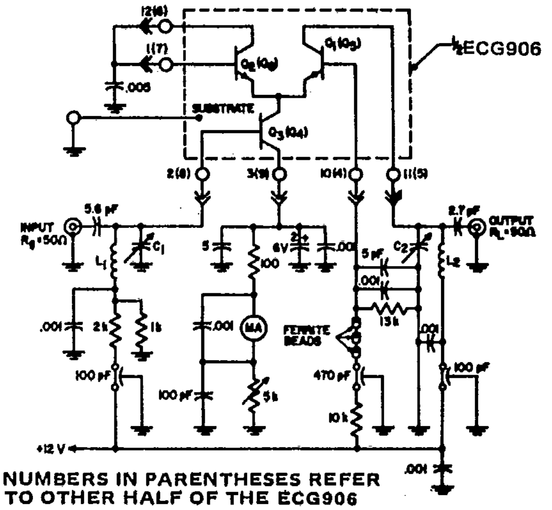


NUMBERS IN PARENTHESES REFER TO OTHER HALF OF THE ECG906

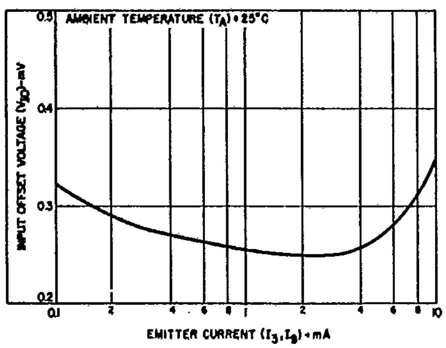
L_1, L_2 – Approx. 1/2 Turn #18 Tinned Copper Wire, 5/8" Dia.

C_1, C_2 – 15 pF Variable Capacitors (Hammarlund, MAC-15; or Equivalent)

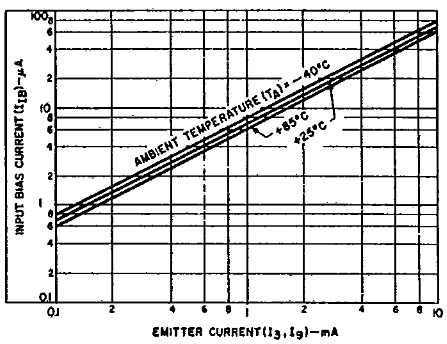
All Capacitors in μF Unless Otherwise Indicated

All Resistors in Ohms Unless Otherwise Indicated

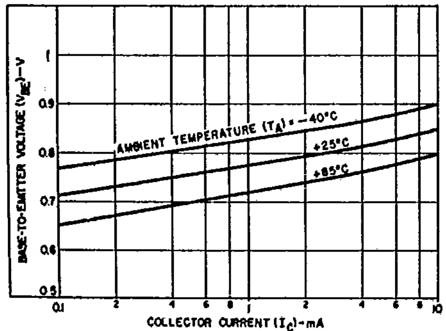
Typical Characteristics



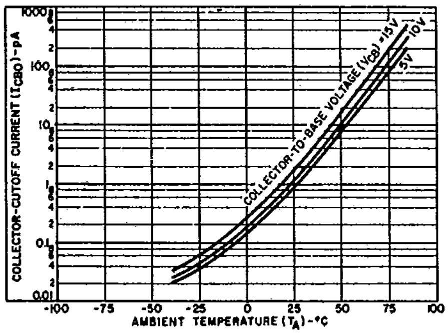
Input offset voltage vs. emitter current.



Input bias current vs. emitter current.



Base-to-emitter voltage vs. collector current.



Collector-cutoff current vs. temperature.

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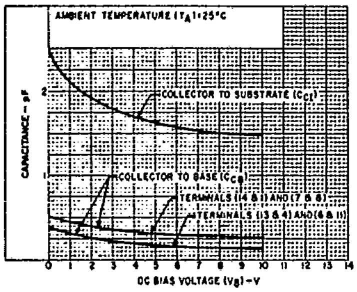
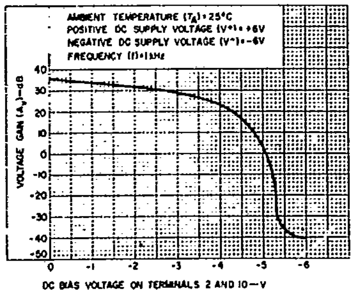
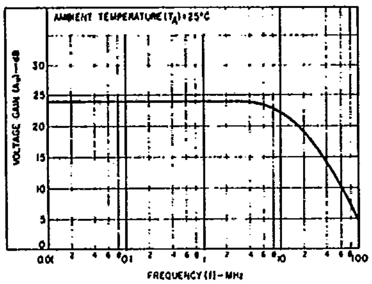
Typical Characteristics (cont'd)



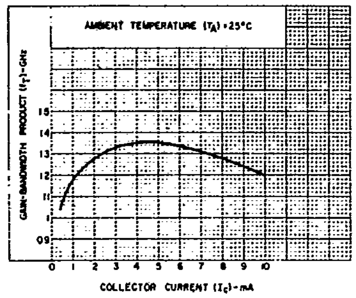
Capacitance vs. dc bias voltage.



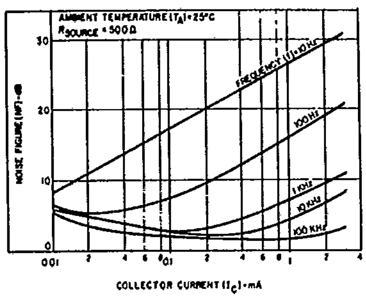
Voltage gain vs. dc bias voltage.



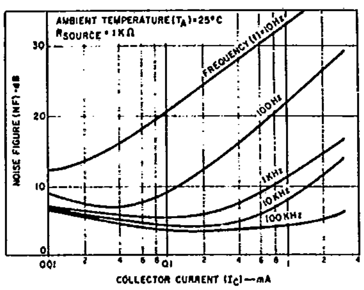
Voltage gain vs. frequency.



Gain-bandwidth product vs. collector current.

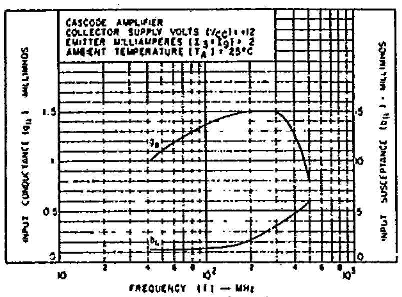


1/f noise figure vs. collector current.

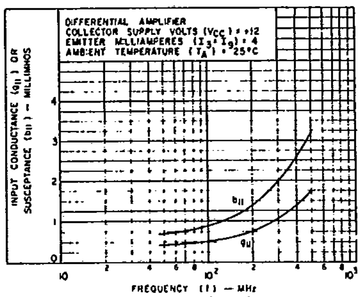


1/f noise figure vs. collector current.

Typical Input Admittance Characteristics



Input admittance (Y_{11}) vs. frequency.



Input admittance (Y_{11}) vs. frequency.

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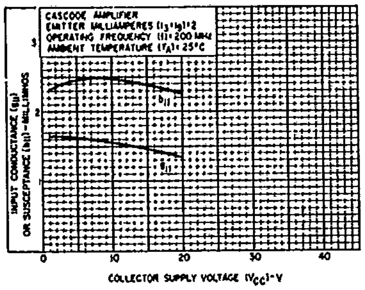
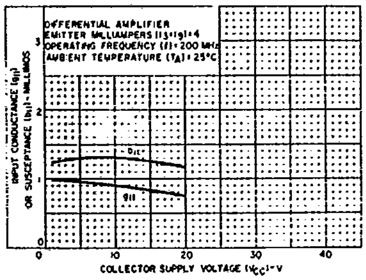
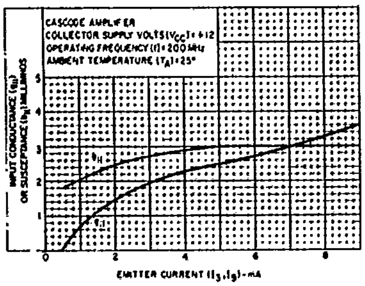


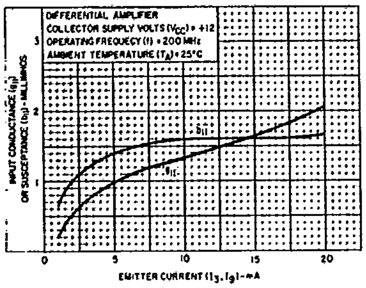
Input admittance (Y_{11}) vs. collector supply voltage.



Input admittance (Y_{11}) vs. collector supply voltage.

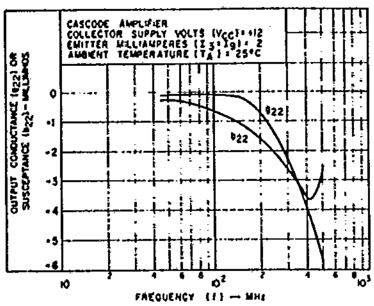


Input admittance (Y_{11}) vs. emitter current.

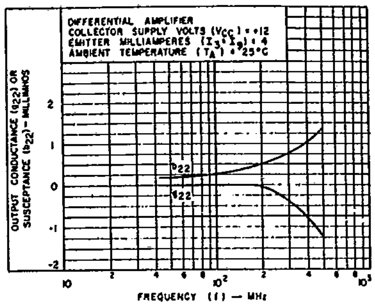


Input admittance (Y_{11}) vs. emitter current.

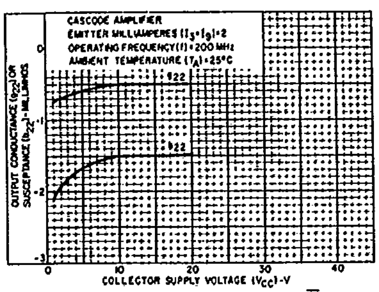
Typical Output Admittance Characteristics



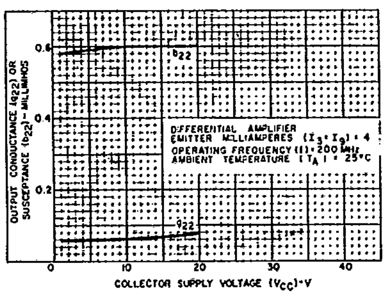
Output admittance (Y_{22}) vs. frequency.



Output admittance (Y_{22}) vs. frequency.



Output admittance (Y_{22}) vs. collector supply voltage.



Output admittance (Y_{22}) vs. collector supply voltage.

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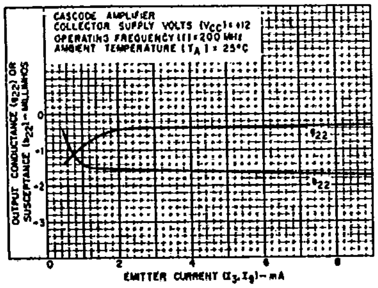
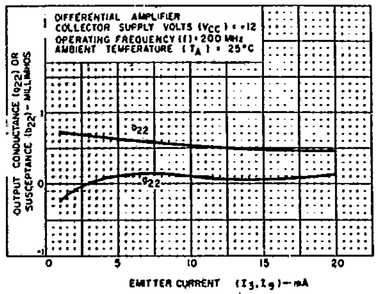
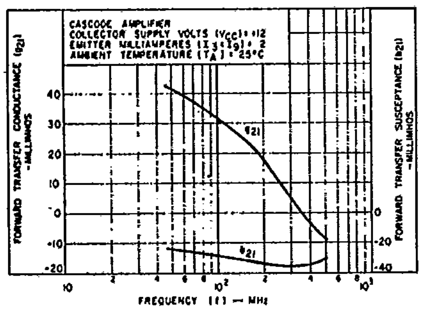


Output admittance (Y_{22}) vs. emitter current.

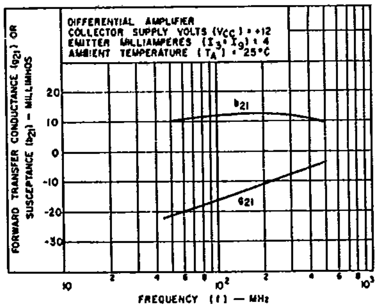


Output admittance (Y_{22}) vs. emitter current.

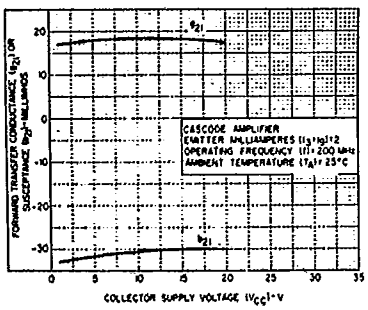
Typical Forward Transfer Characteristics



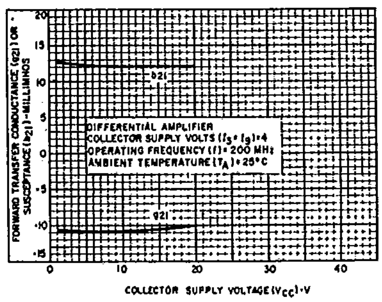
Forward transfer admittance (Y_{21}) vs. frequency.



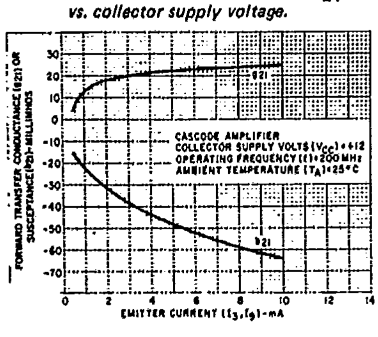
Forward transfer admittance (Y_{21}) vs. frequency.



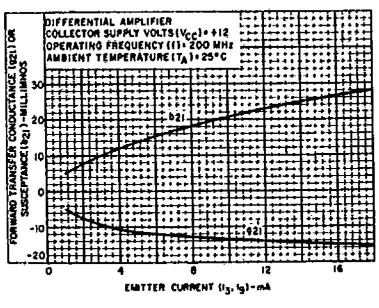
Forward transfer admittance (Y_{21}) vs. collector supply voltage.



Forward transfer admittance (Y_{21}) vs. collector supply voltage.



Forward transfer admittance (Y_{21}) vs. emitter current.



Forward transfer admittance (Y_{21}) vs. emitter current.